

Re: National Telecommunications Information Administration's (NTIA) First Responder Network (FirstNet) Draft Programmatic Environmental Impact Statement (DPEIS) for the Western United States

Comments to be submitted in their entirety for the Administrative Record.

Submitted by Albert M. Manville, II, Ph.D., C.W.B.

Principal, *Wildlife and Habitat Conservation Solutions, LLC*¹;

Adjunct Professor, Krieger School of Arts and Sciences, Advanced Academic Programs, Johns Hopkins University, Washington DC campus; and

former U.S. Fish and Wildlife Service agency lead on avian-structural impacts — including from collision and radiation impacts to migratory birds from communication towers

September 29, 2016

[FirstNet DPEIS W.U.S. Comments-AMM.docx]

Introduction

I am pleased to provide comments regarding FirstNet's DPEIS for the Western United States. Please consider my comments regarding this DPEIS for the Western United States as representative of national and continental needs and concerns regarding both wildlife and the impacts from communication towers and their radiation. My comments and recommendations are focused on new wireless communication towers which FirstNet will contract to be built and make operational.

Overview of my Assessment

1. Below I provide more details not discussed in Chapter 2 about migratory birds, their status and importance.
2. I recommend — based on DPEIS Chapter 9, Best Management Practices (BMPs) — even stronger selection criteria for new towers, purposely avoiding — as practical and feasible — tower siting and operation in heavily human developed areas and wildlife concentration areas, especially for migratory birds.
3. I make a strong evidentiary case— in reviewing DPEIS Chapter 2 — based on the most recent peer-reviewed scientific literature and professional contacts, that the effects on non-thermal radiation must be included in FirstNet's National Environmental Policy Act (NEPA) review, based on a 2014 agreement with the Department of Interior. Furthermore, I argue that, "*the potential effects of major concern are rare...*" (p. 2-12) is an inaccurate conclusion based on the preponderance of recent new evidence and cumulative database effects.
4. I will show that independent studies from radiation effects should be supported by FirstNet to develop consistent, standardized, agreed-upon radiation metrics, based on peer-reviewed monitoring and testing research protocols. While arguably we have, "*no consistent measures of exposure...*" (p. 2-12), FirstNet has an opportunity to lead in establishing them.
5. I will show that independent scientific research supported by FirstNet could help develop and set exposure guidelines for radio frequency radiation (RFR) effects on wildlife, especially migratory birds, as well as on humans. I assert that the statement, "[we have] *no scientifically agreed upon biological mechanism of harm...*" (p. 2-12) is an incorrect one based on the current scientific evidence, and further that the communications industry continues to spend enormous amounts of money fighting current biological conclusions and recommendations.

¹ whcsllc006@verizon.net

Qualifications

My expertise in wildlife, including migratory birds, and impacts from radiation is extensive. I earned a B.S. in zoology from Allegheny College, an M.S. in natural resources and wildlife management from the University of Wisconsin, Stevens Point, and a Ph.D. from Michigan State University in wildlife ecology and management. More recently, I was designated as a “Certified Wildlife Biologist” (C.W.B.) by The Wildlife Society. During my military service, I was trained by the U.S. Navy in the use of electronic gear, then trained and certified by the Departments of State and Defense as a Mandarin Chinese linguist prior to working for the National Security Agency during my Navy tour of duty. I worked as a Federal wildlife biologist for 17 years, retiring in June 2014 from my position as a Senior Wildlife Biologist with the Division of Migratory Bird Management, U.S. Fish and Wildlife Service (FWS or Service), Headquarters Office, Arlington, VA. I was the Service’s national lead on issues related to anthropogenic causes of bird injury and mortality, including from communication towers. In that capacity, I chaired the Communication Tower Working Group (looking at both avian-tower collisions and avian-radiation impacts), working closely with the Federal Communications Commission (FCC), Federal Aviation Administration, other Federal agencies, all the large tower and cell phone trade associations, several cell phone and tower companies, scientists, academicians, and consultants. I was the FWS project officer for the cutting edge tower lighting study at Michigan State Police communication towers (Gehring et al. 2009, Gehring et al. 2011), served as the project officer for a U.S. Coast Guard tall communication tower study, developed a cell tower research monitoring protocol for the U.S. Forest Service (Manville 2002), crafted a peer-reviewed cell tower radiation monitoring protocol, and represented FWS as lead reviewer on many communication tower projects from cell towers to tall, digital television towers. I have published more than 175 professional and popular papers, chapters (including my current chapter in *Problematic Wildlife: a Cross-Disciplinary Approach*; Springer Publishing, 2016), and book reviews. I was considered my agency’s lead, go-to person on communication tower impacts to migratory birds and continue to work in consulting and teaching capacities on these issues.

Previous Agreement

On February 4, 2014, the Director of the Office of Environmental Policy and Compliance (OEPC), Department of Interior (DOI), sent a letter to the U.S. Commerce Department’s NTIA suggesting regulatory compliance by its FirstNet, a newly created federal entity, implementing development of emergency broadcast systems nationwide (USDOJ 2014). Included in those recommendations were inadequacies which FirstNet had acknowledged and was then proceeding to address. These included inadequacies for conserving migratory birds in Enclosure A of the OEPC letter which I authored while working for the Division of Migratory Bird Management, USFWS. In it, I provided recommendations for addressing bird injury, crippling loss, and death from communication tower collisions; and research needs for beginning to address impacts from non-ionizing electromagnetic radiation emitted from such towers.

The take-home message was clear. We had a federal agency (FirstNet) willing to recognize and begin addressing the impacts of radiation on migratory birds — a significant and important step forward. On February 27, 2014, I began communicating with FirstNet’s Director of Environmental Compliance regarding their PEIS, including beginning to address impacts from low-level, non-thermal non-ionizing radiation that FirstNet stated they then did not intend to categorically exclude. We met with FirstNet’s Director of Environmental Compliance and her staff on March 20, 2014, and proceeded to help FirstNet further develop their DPEIS.

FCC standards dealing with tower radiation are flawed and continue to be based solely on thermal heating, now more than 30 years out of date. FCC, to date, has been unwilling to update their radiation regulatory standards while, to their credit, they are updating tower lighting, height and guy-wire standards. Significantly lower radiation output does not equate to reduced risk (e.g., Panagopoulos and Margaritis (2008).

I hope FirstNet officials will evaluate their current position based on the recommendations that follow.

Background

Recapping, the electromagnetic radiation standards used by the FCC continue to be based on thermal heating, a criterion now more than 30 years out of date and inapplicable today — except when one is very close to a base station antenna where thermal radiation is at issue. For example, for health and safety reasons, the FCC requires that power to cell and other communication towers must be turned off during maintenance by tower workers.

The current electromagnetic radiation issues are primarily due to the lower levels of radiation output from microwave-powered communication devices such as cellular telephones and their cell towers, emergency broadcast antennas, Wi-Fi, so called “smart meters,” and other sources of point-to-point communications; levels typically lower than from microwave ovens. The FCC’s radiation standards are currently being legally challenged at cell towers in the U.S. Migratory birds are impacted by these tower structures and their broadcasting/receiving radiation, including by very low levels of non-thermal radiation.

Why Are Migratory Birds Important?

Migratory birds — i.e., those that migrate across U.S., Canadian and/or Mexican borders, of which 1,027 species are currently protected in the United States (50 C.F.R. 10.13 list), are a public trust resource, meaning they belong to everyone. Most birds in the western United States are migratory as they are elsewhere in the U.S. Almost all North American continental birds are protected by the Migratory Bird Treaty Act (MBTA). The Act implements and regulates bilateral protocols with Canada, Mexico, Japan and Russia. It is a strict liability statute; proof of criminal intent in the injury or killing of birds is not required by enforcement authorities for cases to be made.

The statute and its regulations protect migratory birds, their parts, eggs, feathers and nests from un-permitted possession and “take” (i.e., un-permitted injury, crippling loss, or killing). Migratory bird nests are protected during the breeding season while eagle nests are protected year-round. Efforts are currently underway by FWS to develop a permit where un-permitted and “unintentional take” could be allowed under MBTA; that process began in 2001. A Federal permit is required to possess a migratory bird and its parts, but the MBTA currently provides no provision for the accidental or incidental “take” (causing injury, crippling loss, or death — including from tower collisions and from radiation) of a protected migratory bird, even when otherwise normal, legal business practices or personal activities are involved, such as the construction and operation of the FirstNet emergency broadcast system. The U.S. Congress noted the “take” of even one protected migratory bird to be a violation of the Statute, with fines and criminal penalties that can be extensive. Under the purview of the MBTA and Executive Order 13186 (the Migratory Bird EO), agencies such as FirstNet need to make every effort to “avoid and minimize take” of migratory birds. You already reference in Chapter 9 of this DPEIS the FWS 2013 voluntary communication tower guidelines which I updated, authored and provided to FCC (Manville 2013b), in addition to other BMPs such as the Avian Power Line Interaction Committee guidelines (APLIC 2006, 2012), both which I co-authored.

Bald and Golden Eagles are also protected by the Bald and Golden Eagle Protection Act (BGEPA), another strict liability statute. “Take” under BGEPA is more expansive than under MBTA, and includes pursuit, shooting, poisoning, capturing, killing, trapping, collecting, molesting and disturbing both species (50 C.F.R. 22.3). It is important to note that eagles do not simply need to be killed or injured to be in violation of the Eagle Act. “Disturbance take” could result in reduced survivorship of adults, juveniles and chicks, affecting their population viability, including from the construction and operation of FirstNet towers. These “takes” are potential criminal offenses.

Status of Migratory Birds:

Migratory birds are in trouble, including impacts from individual structures and the cumulative communication tower network continent-wide. There are growing numbers of Birds of Conservation Concern (BCCs; USFWS 2008) — species in decline but not yet ready for federal listing as threatened or endangered under the Endangered Species Act (ESA), although some are under listing review. Currently there are 273 species (out of 1,027 protected birds) and subspecies on the national BCC, Service Regional BCC and Bird Conservation Region BCC lists, providing an early warning of likely peril unless the population trends are reversed.

Additionally, there are 93 endangered and threatened bird species on the ESA List of Threatened and Endangered Species. Collectively, BCC and ESA-listed birds represent at least 366 bird species (36%) in decline — some seriously — with numbers of both listed and BCC species growing (Manville 2013a). The FWS is also tasked to maintain stable or increasing breeding populations of Bald and Golden Eagles under implementing regulations of BGEPA and compliance with NEPA — including for broadcast towers.

Bird Collisions:

Migratory birds have been documented killed in single night, mass mortality collision events (up to 10,000 in single night, single tower collision events) with communication towers, guy-support wires, and tower lights in the U. S. since 1948 — Aronoff 1949, summarized in Manville 2007 — including at ungued, unlit, < 200-ft above-ground-level (AGL) cell towers.

During nighttime migrations, birds can be overwhelmed by inclement weather events, forcing bird fall-out, significant reductions in flight heights, and resultant attraction to lighted structures and confusion (Manville 2014, 2016a) — such as security lighting that may be placed at power sheds, attracting birds, causing them to collide with the towers. Currently an estimated 6.8 million birds/yr are killed in the U.S. and Canada (Longcore et al. 2012). The vast majority of these bird deaths are in the U.S. In another review, at least 13 species of BCCs were estimated to suffer annual mortality of 1-9% of their estimated total population based solely on communication tower collisions in the U.S. or Canada (Longcore et al. 2013). These include estimated annual mortality of > 2% for the Yellow Rail, Swainson’s Warbler, Pied-bill Grebe, Bay-breasted Warbler, Golden-winged Warbler, Worm-eating Warbler, Prairie Warbler, and Ovenbird.

Up to 350 species of birds have been documented killed at communication towers (Manville 2014, 2016a). Each time one of these birds is killed at an individual communication tower such as that planned by FirstNet, these “takings” add to the overall impacts to bird populations not unlike the phenomenon of the “death by a thousand cuts.” That, of course, is a important purpose of your DPEIS — investigate cumulative effects.

Radiation:

While there is a massive and growing global database — studies being published weekly — on effects of tower and other non-ionizing radiation on wildlife, laboratory animals and humans, and it is important to

note that the impacts from both thermal and non-thermal radiation have already been well documented (e.g., www.saferemr.com). In fact, most scientists consider non-thermal effects as well established even though all of the implications are not yet fully understood. Thermal effects are generally pretty clear. It is also important to note that tests on laboratory animals referenced in a radiation memo I provided to FCC in early 2016, and updated for release to the public on July 14, 2016 (excerpted herein; Manville 2016b; <http://bit.ly/savewildlifeRFR>), such as those on chicken embryos, mice and rats are used as surrogates to predict harm to humans, protected migratory birds and other wildlife. For practical, ethical and legal reasons, wild migratory birds would not otherwise be subjected to laboratory studies on impacts from radiation. Furthermore, scientists generally do not want to perform harmful experiments on either humans or protected wildlife such as migratory birds. Studies on the negative effects of non-thermal radiation to wild birds in Europe, briefly summarized below, are clearly relevant as predictors of what will, is likely, or is happening to wild birds in North America. These issues therefore need to be examined in detail by FirstNet, not categorically excluded as currently done in FCC's flawed approach.

In the June 2016 *Scientific American Blog* (Portier and Leonard 2016), in response to the question, “do cell phones cause cancer?” The authors response was clear: “*probably, but it's complicated. The degree of risk almost certainly depends on the length and strength of exposure — but we still don't know how significant the actual danger is.*” These same issues pertain to impacts to wildlife from both thermal and non-thermal effects emitted from cell and broadcast communication towers and FM antennas. I submit that the radiation effects on wildlife need to be addressed by the FCC, the Environmental Protection Agency (EPA), FirstNet, the FWS and other governmental entities.

While radiation studies have been ongoing for decades, not until recently have the effects of low-level, non-thermal electromagnetic radiation on domestic and wild birds been made public. Laboratory studies by T. Litovitz (2000 pers. comm.) and DiCarlo et al. (2002) from the standard 915 MHz cell phone frequency on domestic chicken embryos showed that radiation from extremely low levels (0.0001 the level emitted by the average digital cell phone) caused heart attacks and deaths in some embryos; controls were unaffected (DiCarlo et al. 2002). You already referenced these studies in your DPEIS. However, the effects of microwave (and other) radiation from communication towers on nesting and roosting wild birds are yet unstudied in the U.S. In Europe, impacts have been well documented. Balmori (2005) found strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of electromagnetic fields in Spain. He documented nest and site abandonment, plumage deterioration, locomotion problems, and death in House Sparrows, White Storks, Rock Doves, Magpies, Collared Doves, and other species. While these species had historically been documented to roost and nest in these areas, Balmori (2005) did not observe these symptoms prior to construction of the cellular phone towers.

In a troubling discovery, Balmori (2005) documented “far-field,” low level radiation exposures affecting migratory birds out to 300 meters (nearly 1,000 ft) distance from cell towers in Europe. Twelve nests (40% of his study sample) were located within 200 m (nearly 660 ft) of the antennas and never successfully raised any chicks, while only 1 (3.3%), located further than 300 m, never had chicks. Strange behaviors were observed at White Stork nesting sites within 100 m (328 ft) of one or several cell tower antennas. Those birds that the main beam impacted directly (i.e., electric field intensity/EFI > 2 V/m) included young that died from unknown causes. Within 100 m, paired adults frequently fought over nest construction sticks and failed to advance the construction of the nests with sticks falling to the ground while nests were being constructed. Balmori (2005) reported that some nests were never completed and the Storks remained passively in front of cellsite antennas. The electric field intensity was higher on nests within 200 m (2.36 ± 0.82 V/m) than on nests further than 300 m (0.53 ± 0.82 V/m). However, the EMF levels, including for nests < 100 m from the antennas, were not intense enough to be classified as thermally active. Power densities need to be at least 10 mW/cm² to produce tissue heating of even 0.5 C

(Bernhardt 1992). The radio frequencies used in Europe and here in the U.S. are similar to the 700 MHz frequency band FirstNet is planning to utilize.

Balmori and Hallberg (2007) and Everaert and Bauwens (2007) found similar strong negative correlations among male House Sparrows. In another review, Balmori (2009) reported health effects to birds which were continuously irradiated. They suffered long-term effects including reduced territorial defense posturing, deterioration of bird health, problems with reproduction, and reduction of useful territories due to habitat deterioration.

Beason and Semm (2002) demonstrated that microwave radiation used in cell phones produces non-thermal responses in several types of neurons of the nervous system of Zebra Finches. The brain neurons of anesthetized birds were tested with a 900 MHz carrier, modulated at 217 Hz. Stimulation resulted in changes in the amount of neural activity by more than half of the brain cells with most (76%) of the responding cells increasing their rates of firing by an average 3.5-fold as opposed to controls — a clearly definitive study showing non-thermal effects. The other responding cells exhibited a decrease in their rates of spontaneous activity suggesting potential effects to humans using hand-held cell phones affecting sleep (Borbely et al. 1999). The Beason and Semm (2002) theoretical model could also help explain why birds may be attracted to cell towers, an important theoretical premise that they previously hypothesized in regard to Bobolinks (Semm and Beason 1990).

Radiation effects can be characterized as “*near-field*” (near the source of radiation), “*far-field*” (some distance from the source) or “*intermediate*.” The growing evidence is clear; there are low-level, non-thermal effects (Manville 2016b: p.4; <http://bit.ly/savewildlifeRFR>). In a meta-review of studies through 2008, and based on laboratory research they conducted, Panagopoulos and Margaritis (2008) determined maximum radiation distances for both cell phones and for communication towers, based on the Global System for Mobile Telecommunications (GSM) and the Digital Cellular System (DCS). This maximum radiation distance corresponds to an intensity around 10 mW/cm² for both types of radiation in regards to the RF components — i.e., Bernhardt’s (1992) threshold for thermal heating effects. In the Panagopoulos and Margaritis (2008) study, a “near-field” thermal effect which they called an “*intensity window*” appeared at a distance of 20-30 cm for the cell phone antenna, corresponding to a distance of 20-30 meters (66 to 98 feet) from the base antenna. This could be considered a classic nonlinear effect and would also apply to far field exposures where effects from an “intensity window” are greater than expected. Since cell phone base station antennas are frequently located within residential areas where houses and workplaces are often situated at distances 20-30 m from such antennas, not to mention birds nesting and roosting close to these antennas (e.g., Balmori 2005), humans, migratory birds and other wildlife may be exposed up to 24 hours per day. As a recommended mitigation measure, FirstNet should avoid siting any new broadcast antennas in close proximity to human development and in areas prone to heavy migratory bird use — where there are practical and reasonable alternatives. The FWS’s 2013 guidelines (Manville 2013b), referenced within the DPEIS, provide some recommendations of where to locate antennas.

Complicating the issue is the fact that there currently are no standards for wildlife exposure, including by the licensing and regulatory rules and procedures of the FCC. Other than the letter to and “agreement” between DOI and FirstNet, neither DOI nor the FWS have any policy or quasi policy that currently addresses radiation effects on migratory birds — with the exception of the 2013 (Manville 2013: p.2) guideline number 5. recommending at least a 1-mile disturbance-free buffer between new cell towers and nesting Bald Eagles and Ferruginous Hawks. Arguably, “effects” need to be determined by the EPA, which has no funding for this, and regulated as part of a NEPA site review process, including both thermal and non-thermal effects.

There is an increasing body of published laboratory research that finds DNA damage at low intensity exposures — well below levels of thermal heating — which may be comparable to far field exposures from cell and broadcast antennas, including those being constructed or to be used by FirstNet. This body of

work would apply to all species, including migratory birds, since DNA is DNA, whether single-strand or double helix. The first study to find such effects was conducted by H. Lai and N.P. Singh in 1995 (Lai and Singh 1995). Their work has since been replicated (e.g., Lai and Singh 1996, as well as in hundreds of other more recent published studies), performed in at least 14 laboratories worldwide. The take-home message is clear: low level transmission of EMF from cell and other broadcast towers and other sources probably causes DNA damage. The laboratory research findings strongly infer this relationship. Since DNA is the primary building block and genetic “map” for the very growth, production, replication and survival of all living organisms, deleterious effects can be critical.

The entire thermal model and all FCC categorical exclusions for all of the electronic devices we see today, rests on the incorrect assumption that low-level, non-ionizing non-thermal radiation cannot cause DNA breaks because it is “*so low-power*” (B. Levitt and H. Lai, Comments Filed Jointly to FCC, ET Docket No. 13-84, 2013). The evidence strongly supports the opposite conclusion: low power produces negative effects. These issues need to be adequately addressed by the appropriate authorities including the FCC, EPA, FWS, and FirstNet. Currently they are not.

Based on their research and meta-analyses, Panagopoulos and Margaritis (2008) concluded that large decreases in reproductive capacity were being caused by GSM and DCS radiation fields. This included extensive DNA fragmentation on reproductive cells of experimental animals induced by these fields, exerting an intense biological action able to kill cells, damage DNA, and dramatically decrease the reproductive capacity of living organisms, including populations of wild birds and insects. They cautioned, however, that the physical parameters of these radiations, including intensity, carrier frequency, pulse repetition frequency, distance from the antenna, and similar factors provided inconsistency and lack of standardization making it difficult to correlate specific thermal and non-thermal effects to specific types of radiation. Their take-away message, however, was clear: bio-effects to migratory birds, other wildlife, insects, laboratory animals and humans continue to be documented from thermal and non-thermal exposures, as well as effects from intermediate exposures between the near-field and far-field levels. All migratory birds are potentially at risk, whether they be Bald Eagles, Golden Eagles, Birds of Conservation Concern (USFWS 2008), Federally and/or State-listed bird species, other birds in peril regionally or population-wide, or birds whose populations are stable. FirstNet must therefore address these issues in the DPEIS and your subsequent implementing instructions. Ignoring non-thermal effects based on flawed FCC standards would not be acceptable.

Cucurachi et al. (2013) reported on 113 studies from original peer-reviewed publications and relevant existing reviews. A limited number of ecological studies was identified, the majority of which were conducted in a laboratory setting on bird embryos or eggs, small rodents and plants. In 65% of the studies, ecological effects of RF-EMF (50% of the animal studies and about 75% of the plant studies) were found both at high as well as at low dosages. Lack of standardization and limited sampling made generalizing results from the organism to the ecosystem level very difficult. Cucurachi et al. (2013) concluded, however, that due to the number of variables, no clear dose–effect relationship could be found especially for non-thermal effects. However, effects from some of the studies reviewed were well documented, and certainly can serve as predictors for effects to wild, protected migratory birds and other wildlife in North America.

Engels et al. (2014) investigated “*electromagnetic noise*” emitted everywhere humans use electronic devices including from cell phones and their towers. While prior to their study on European Robins, no “*noise effect*” had been widely accepted as scientifically proven, the authors in this double-blind experiment were able to show that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise. The magnetic compass is integral to bird movement and migration. The findings clearly demonstrated a non-thermal effect on European Robins and clearly serves as a predictor for effects to other migratory birds including those in North America.

Levitt and Lai (2010) reported numerous biological effects from cell tower radiation documented at very low intensities comparable to what the population experiences within 60- 150 m (197- 492 ft) distance from a cell tower, including effects that occurred in studies of cell cultures and animals after exposures to low-intensity RFR. These reported effects were genetic, growth, and reproductive in nature; they documented increases in permeability of the blood–brain barrier; showed behavioral responses; illustrated molecular, cellular, and metabolic changes; and provided evidence of increases in cancer risk — all applicable to migratory birds, other wildlife and to far field exposures in general. They cited published, peer-reviewed examples of effects that included:

Dutta et al. (1989) who reported an increase in calcium efflux in human neuroblastoma cells after exposure to RFR at 0.005 W/kg. Calcium is an important component in normal cellular functions.

Fesenko et al. (1999) who reported a change in immunological functions in mice after exposure to RFR at a power density of 0.001 mW/cm². These results can serve as predictors for impacts to wild animals.

Magras and Xenos (1997) who reported a decrease in reproductive function in mice exposed to RFR at power densities of 0.000168— 0.001053 mW/cm². The results also serve as predictors for reproductive impacts to wildlife.

Forgacs et al. (2006) who reported an increase in serum testosterone levels in rats exposed to GSM-like RFR at specific absorption rates (SAR) of 0.018— 0.025 W/kg. The results also serve as predictors for reproductive impacts to wildlife.

Persson et al. (1997) who reported an increase in the permeability of the blood–brain barrier in mice exposed to RFR at 0.0004– 0.008 W/kg. The blood–brain barrier is a physiological mechanism that protects the brain from toxic substances, bacteria, and viruses. These findings have clear applicability to wildlife including migratory birds.

Phillips et al. (1998) who reported DNA damage in cells exposed to RFR at the SAR of 0.0024– 0.024 W/kg. DNA is integral to the very function and survival of all living organisms, including migratory birds.

Kesari and Behari (2009) also reported an increase in DNA strand breaks in brain cells of rats after exposure to RFR at the SAR of 0.0008 W/kg. The results also serve as predictors for impacts to DNA in wildlife. And,

Belyayev et al. (2009) who reported changes in DNA repair mechanisms after RFR exposure at a SAR of 0.0037 W/kg. DNA is integral to the maintenance and repair of cells and cellular function in all animals. All sources from above were cited in Levitt and Lai (2010).

In a 2-year study conducted by the National Toxicology Program (NTP) of the National Institutes of Health (May 2016), NTP (Wyde 2016) reported partial findings from their \$25 million study on cancer risk to laboratory rodents from cellphone radiation. The report summarizes a long-term exposure study to cell phone radiation, with statistically significant evidence of DNA damage from non-thermal exposure to cellphone radiation to laboratory mice and rats. Controlled studies on laboratory rats showed that cellphone radiation caused 2 types of tumors, glioma and schwannoma, the results which “*could have broad implications for public health.*” The report has been characterized as a “*game-changer*” as it proves that non-ionizing, radiofrequency radiation can cause cancer without heating tissue. The researchers controlled the temperature of the test animals to prevent heating effects so the cancers were caused by a non-thermal mechanism. The report on the mice component of the study will be released at a later date. Not

surprisingly, much of the media coverage contained considerable bias or “media spin” intended to create doubt about the study’s important findings regarding cancer risk from exposure to cellphone radiation (Moskowitz 2016). The implications are troubling for migratory birds and other wildlife.

Summary Recommendations

Levitt and Lai (2010) concluded that the obvious mechanism of effects from RFR are thermal (i.e., tissue heating) — which is what FCC bases its current radiation standards on, even if they are more than 30 years out of date and rejected both by the Department of Interior and Department of Commerce (USDOJ 2014, Manville 2016a) as incomplete. However, for decades, there have been questions about non-thermal (i.e., not dependent on a change in temperature) effects, whether they exist, and what specifically causes the effects to surface. The sources cited above should help dispel that doubt or at the very least show that non-thermal effects do indeed occur, have been well documented, and can have significant deleterious effects on migratory birds and other wildlife.

Practically, as Levitt and Lai (2010) concluded, we do not actually need to know whether RFR effects are thermal or non-thermal to set exposure guidelines. Most of the biological-effects studies of RFR that have been conducted since the 1980s were under non-thermal conditions, including the most recent NTP (2016) studies. In studies using isolated cells, the ambient temperature during exposure was generally well controlled. In most animal studies, the RFR intensity used usually did not cause a significant increase in body temperature in the test animals. Most scientists consider non-thermal effects as well established, even though the implications are not fully understood.

Scientifically, Levitt and Lai (2010) concluded that there are three rationales for the existence of non-thermal effects:

1. Effects can occur at low intensities when a significant increase in temperature is not likely.
2. Heating does not produce the same effects as RFR exposure.
3. RFR with different modulations and characteristics produce different effects even though they may produce the same pattern of SAR distribution and tissue heating.

There is virtually no non-thermal research to indicate what is safe for either humans or wildlife, including migratory birds which are highly sensitive to perturbations in ways humans are not (see previous citations). Unfortunately, there also is very little far-field, distance-to-safety research for wildlife — most especially for migratory birds — as this has not been studied with that focus in mind. What little EMF/RF field research on wildlife that has been conducted, its focus has been on behavior, mortality and reproductive outcomes (e.g., B. Levitt and H. Lai, Comments Filed Jointly to FCC, ET Docket No. 13-84, 2013; Balmori 2005, 2009; Balmori and Hallberg 2007; Everaert and Bauwens 2007; Engels et al. 2014; Wasserman et al. 1984; and Semm and Beason 1990).

In summary, we need to better understand, tease out, and refine how to address these growing and poorly understood radiation impacts to migratory birds, bees, bats, and myriad other wildlife. Currently, other than to proceed using the precautionary approach and keep emissions as low as reasonably achievable, we are at loggerheads in advancing meaningful guidelines, policies and regulations that address non-thermal effects. The good news: there appears to be an awakening at least within a significant segment the scientific community to the realization that these issues must be addressed — for the health of humans, wildlife and our environment — and hopefully FirstNet will continue on the course of assessing how to minimize the impacts of radiation on wildlife and humans as had been agreed to in 2014.

Suggested Next Steps for FirstNet

The following suggestions would help significantly advance the need to address effects/impacts from non-thermal radiation on migratory birds and other wildlife, and help in further reducing collision impacts and habitat fragmentation:

- We desperately need to conduct field research on thermal and non-thermal radiation impacts to wild migratory birds and other wildlife here in North America, similar to studies conducted in Europe. Specifically, the research focus should center on causality for “*near-field*,” “*far-field*” and “*intermediate*” effects, ideally based on some standard, agree-upon radiation metrics. FirstNet and leading independent radiation experts (ideally none affiliated with the communication industry) should work together to develop radiation metrics. The metrics need to be consistent with standards for intensity, carrier frequency, pulse repetition frequency, distance from the antenna, and similar factors. The research must be based on peer-reviewed monitoring and testing protocols (e.g., upgrades to the Manville 2002 peer-reviewed research protocol submitted to the U.S. Forest Service for studies on cell towers in Arizona, and key methodologies used in studies previously referenced in the Manville [2016b] memo, among others). The research needs to be conducted by credible, independent third party research entities with no vested interest in the outcomes, and the results need to be published in refereed scientific journals, made available to the public and the affected federal agencies.
- Studies need to be designed to better tease out and understand causality of thermal and non-thermal impacts from radiation on migratory birds. Results need to be carefully compared with findings from Europe and elsewhere on wild birds, and efforts need to be made to begin developing exposure guidelines for migratory birds and other wildlife based on dose-effect and other nonlinear relationships. We do not actually need to know whether RFR effects are thermal or non-thermal to develop and set exposure guidelines (Levitt and Lai 2013).
- To minimize deleterious radiation exposures, these guidelines should include use of avoidance measures such as those developed by the electric utility industry for bird collision and electrocution avoidance (APLIC 2006, 2012). In the case of Bald Eagles, the communication tower guidelines refined and updated by FWS (Manville 2013b) — and submitted to the FCC and industry — recommend one-mile disturbance free buffers during active nesting of Ferruginous Hawks and Bald Eagles, and 0.5-mile buffers around other active raptor nests, based on nest studies conducted by the Wyoming Ecological Services Field Office in that State; Guideline number 5. Impacts must address collision mortality, crippling loss, and injury; mortality, injury, population viability and survivorship based on impacts from radiation; as well as disturbance and habitat fragmentation. The updated 2013 Service Guidelines were intended to be inclusive.
- Agencies tasked with the protection, management, and research on migratory birds and other wildlife (e.g., FWS, U.S. Geological Survey, National Park Service, U.S. Forest Service, Bureau of Land Management, and USDA Wildlife Services, among others) need to develop radiation policies that avoid or minimize impacts to migratory birds and other trust wildlife species. This means supporting — and where applicable — conducting research, and developing policies that help minimize radiation impacts. FirstNet can work with these agencies in support of these efforts.
- As Levitt and Lai (2010) concluded, we do not actually need to know whether RFR effects are thermal or non-thermal to set exposure guidelines. Most scientists consider non-thermal effects as well established, even though the implications are not fully understood.

- Given the rapidly growing database of peer-reviewed, published scientific studies (e.g., <http://www.saf-eremr.com>, School of Public Health, University of California, Berkeley), it is time these issues be addressed both by FCC and NTIA.
- Without question, these are challenging and daunting issues. FirstNet can begin by taking “small bites out of this 800 pound gorilla” first by developing a siting review process for new towers based on bird- and human-friendly habitats — using the precautionary approach as the direction forward — much like what FWS did following release of its 2000 guidance through a site review process. Proper site location will help to minimize collision and radiation impacts, especially given the scientific information we have available (many sources referenced within these comments). Meanwhile, FirstNet needs to proceed as agreed to in 2014 with helping support independent field radiation research, including in the DPEIS review process, implementing instructions, and through funding and agency support. It is important for FirstNet to begin focusing on new tower siting and location — given the enormity of this endeavor. Implementing the BMPs recommended in this DPEIS and suggestions provided in these comments would be a good start.

Thank you for the opportunity to comment on this complicated but incredibly important issue. Hopefully reasoned minds will prevail, impacts of non-thermal radiation will be included as part of this review, and BMPs will result in a significant reduction of impacts to migratory birds, other wildlife and humans.

Respectfully submitted

Albert M. Manville, II, Ph.D., C.W.B.

LITERATURE CITED

Aronoff, A. 1949. The September migration tragedy. *Linnaean News-Letter* 3(1):2.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC, and Sacramento, CA. 207 pp.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing avian collisions with power lines: the state of the art in 2012. Edison Electric Institute and APLIC, Washington, DC. 159 pp.

Balmori, A. 2005. Possible effects of electromagnetic fields from phone masts on a population of White Stork (*Ciconia ciconia*). *Electromagnetic Biology and Medicine* 24:109-119.

Balmori, A. 2009. Electromagnetic pollution from phone masts. Effects on wildlife pathophysiology. *Electromagnetic Fields (EMF) Special Issue*, 16 (2-3): 191-199.

Balmori, A., and O. Hallberg. 2007. The urban decline of the House Sparrow (*Passer domesticus*): a possible link with electromagnetic radiation. *Electromagnetic Biology and Medicine* 26:141-151.

Beason, R.C., and P. Semm. 2002. Responses of neurons to amplitude modulated microwave stimulus. *Neuroscience Letters* 333 (2002):175-178. Carter, E. 2013. Birding in the United States: demographic and economic analyses. U.S. Fish and Wildlife Service Report 2011-1, 16 pp. Arlington, VA

Bernhardt, J.H. 1992. Non-ionizing radiation safety: radiofrequency radiation, electric and magnetic fields. *Phys. Med. Biol.* 37 (1992): 80–84.

Borbely, A.A., R. Huber, T. Graf, B. Fuchs, E. Gallmann, and P. Achermann. 1999. Pulsed high-frequency electromagnetic field affects human sleep and sleep electroencephalogram. *Neurosci. Lett.* 275 (1999): 207–210.

Cleveland, R.F., Jr. 2001. Human exposure to radiofrequency electromagnetic fields: FCC guidelines; global standards; evaluating compliance; Federal and local jurisdiction. Pages 116-128 *In* B.B. Levitt (ed.). *Cell Towers: Wireless Convenience” or Environmental Hazard?* Proceedings Cell Tower Forum, New Century Publishing.

Cucurachi, S., W.L.M. Tamis, M.G. Vijver, J.W.G.M. Peijnenburg, J.F.B. Bolte, and G.R. de Snoo. 2013. A review of ecological effects of radio frequency electromagnetic fields (RF-EMF). *Environment International* 51 (January 2013): 116-140. DiCarlo, A., N. White, F. Guo, P. Garrett, and T. Litovitz. 2002. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. *Journal Cellular Biochemistry* 84: 447-454.

DiCarlo, A., N. White, F. Guo, P. Garrett, and T. Litovitz. 2002. Chronic electromagnetic field exposure decreases HSP70 levels and lowers cytoprotection. *Journal Cellular Biochemistry* 84: 447-454.

Engels, S., N-L. Schneider, N. Lefeldt, C.M. Hein, M. Zapka, A. Michalik, D. Elbers, A. Kittel, P.J. Hore, and H. Mouritsen. 2014. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. *Nature* 509 (May 15, 2014). doi:10.1038/nature13290.

Everaert, J. 2016. Electromagnetic radiation (EMR) in our environment. www.livingplanet.be

Everaert, J., and D. Bauwens. 2007. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding House Sparrows (*Passer domesticus*). *Electromagnetic Biology and Medicine* 26:63-72.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2009. Communication towers, lights and birds: successful methods of reducing the frequency of avian collisions. *Ecological Applications* 19(2): 505-514.

Gehring, J., P. Kerlinger, and A.M. Manville, II. 2011. The role of tower height and guy wires on avian collisions with communication towers. *Journal of Wildlife Management* 75(4): 848-855.

Grigor’ev, I. 2003. Biological effects of mobile phone electromagnetic field on chick embryo (risk assessment using the mortality rate). *Radiats Biol Radioecol* 43(5):541-3.

ICNIRP. 1998. Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300GHz). *Health Phys.* 74: 494-522.

Lai, H., and N.P. Singh. 1995. Acute low-intensity microwave exposure increases DNA single-strand breaks in rat brain cells. *Bioelectromagnetics* 16 (1995): 207–210.

Lai, H., and N.P. Singh. 1996. Single and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation. *Int. J. Radiat. Biol.* 69 (1996): 513–521.

Levitt, B.B. 1995. *Electromagnetic Fields: A Consumer’s Guide to the Issues and How to Protect Ourselves*. Harcourt Brace. ISBN 0-15-628100-7

Levitt, B.B., and H. Lai. 2010. Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays. *Environ. Rev.* 18 (2010): 369–395. doi:10.1139/A10-018.

Levitt, B.B., and H. Lai. 2013. Comments Filed Jointly to the Federal Communications Commission, ET Docket No. 13-84, 2013.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2012. An estimate of avian mortality at communication towers in the United States and Canada. *PLoS ONE* 7(4) 17 pp, Open Access.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.C. Crawford, A.M. Manville, II, E.R. Travis, and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? *Biological Conservation* 158: 410-419.

Manville, A.M. II. 2001. Avian mortality at communication towers: steps to alleviate a growing problem. Pp. 75-86, 227-228. *In*: B.B. Levitt (ed.). *Proceedings of the "Cell Towers Forum" State of the Science/State of the Law*, December 2, 2000, Litchfield, CT. ISBN 1-884820-62-X.

Manville, A.M., II. 2002. Protocol for monitoring the impacts of cellular telecommunication towers on migratory birds within the Coconino, Prescott, and Kaibab National Forests, Arizona. Peer-reviewed research monitoring protocol requested by and prepared for the U.S. Forest Service. Division of Migratory Bird Management, USFWS, 9 pp. March 2002.

Manville, A.M., II. 2007. Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds." February 2, 2007. 32 pp.

Manville, A.M. II. 2009. Towers, turbines, power lines and buildings – steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. Pp 262-272 *In* T.D. Rich, C. Arizmendi, D.W. Demarest, and C. Thompson (eds.). *Tundra to Tropics: Connecting Birds, Habitats and People*. *Proceedings 4th International Partners in Flight Conference*, McAllen, Texas.

Manville, A.M., II. 2013a. Anthropogenic-related bird mortality focusing on steps to address human-caused problems. Invited White Paper for the Anthropogenic Panel, 5th International Partners in Flight Conference, August 27, 2013, Snowbird, Utah. Division of Migratory Bird Management, USFWS, peer-reviewed white paper. 16 pp.

Manville, A.M., II. 2013b. U.S. Fish and Wildlife Service (USFWS) revised guidelines for communication tower design, siting, construction, operation, retrofitting, and decommissioning — Suggestions based on previous USFWS recommendations to FCC regarding WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds," Docket No. 08-61, FCC's Antenna Structure Registration Program, and Service 2012 Wind Energy Guidelines. Division of Migratory Bird Management, Arlington, VA. 5 pp.

Manville, A.M., II. 2014. Status of U.S. Fish and Wildlife Service developments with communication towers with a focus on migratory birds: updates to Service staff involved with tower issues — a webinar. *Talking Points and Literature Citations*, Available to the Public. March 7, 13 pp.

Manville, A.M. II. 2015. Recommendations for additional research and funding to assess impacts of non-ionizing radiation to birds and other wildlife. Memorandum to Dr. J. McGlade, Science Advisor to United Nations Environment Program, Key Research Needs Affecting Wildlife Suggesting UNEP's Immediate Attention. March 5, 2 pp.

Manville, A.M., II. 2016a. Impacts to birds and bats due to collisions and electrocutions from some tall structures in the United States: wires, towers, turbines and solar arrays — state of the art in addressing the problems. Chap 20, pp 415-442, *In* F.M. Angelici (editor), *Problematic Wildlife: a Cross-Disciplinary Approach*, Springer International Publishing, Switzerland. DOI 10.1007/978-3-319-22246-2_20

Manville, A.M., II. 2016b. A briefing memo: what we know, can infer, and don't yet know about impacts from thermal and non-thermal non-ionizing radiation to birds and other wildlife — for public release. Peer-reviewed briefing memo, July 14, 2016, 12 pp.

Moskowitz, J.M. 2016. National Toxicology Program finds cell phone radiation causes cancer. Electromagnetic Radiation Safety. J. Moskowitz, Dir., Center for Family and Community Health, School of Public Health, Univ. CA— Berkeley. www.saferemr.com/2016/05/national-toxicology-program-finds-cell.html

Panagopoulos, D.J., and L.H. Margaritis. 2008. Mobile telephony radiation effects on living organisms. Chapter 3, pp. 107-149, *In* A.C. Harper and R.V. Buress (eds.), *Mobile Telephones*, Nova Science Publishers, Inc. ISBN: 978-1-60456-436-5.

Portier, C.J., and W.L. Leonard. 2016. Scientific American Blog. June 13.

Semm, P. and R.C. Beason. 1990. Responses to small magnetic variations by the trigeminal system of the bobolink, *Brain Res. Bull.* 25: 735–740.

Tanner, J.A. 1966. Effects of microwave radiation on birds. *Nature* 210, May 7, Letters to Nature, doi: 10.1038/210636a0

Tanner, J.A., C. Romero-Sierra, and S.J. Davie. 1967. Non-thermal effects of microwave radiant on birds. *Nature* 216. *Nature* 216, 1139 (Dec 16, 1967) doi:10.1038/2161139a0

United States Department of Interior. 2014. ER 14/0001-14/0004. Letter to Mr. Eli Veenendaal, Natl. Telecommunications and Information Administration, US Dept. Commerce. Signed by W.R. Taylor, Director Office of Environmental Policy and Compliance, Office of Secretary, DOI. February 7, 8 pp, in the public arena.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pp. (<http://www.fws.gov/migratorybirds/>>).

Wasserman, F.E., C. Dowd, B.A. Schlinger, D. Byman, S.P. Battista, and T.H. Kunz. 1984. The effects of microwave radiation on avian dominance behavior. *Bioelectronmagnetics* 5(3): 331-339.

Wyde, M. 2016. National Toxicology Program finds cell phone radiation causes cancer. Summary Presentation at BioEM 2016 Meeting, Ghent, Belgium, by M. Wyde, Dir. NTP Studies of Cell Phone Radiation, NIEHS, June 8.

Xenos, T.D, and I.N. Magras. 2003. Low power density RF radiation effects on experimental animal embryos and fetuses *In*: P. Stavroulakis (Ed.), Biological Effects of Electromagnetic Fields, Springer, 579-602.